Impact of Typhoons on the Western Pacific: Observing the Evolution of Typhoon Wakes

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LONG-TERM GOALS

We are investigating the temporal and spatial evolution of the impact of typhoons on the upper ocean. In particular we plan to directly observe the mixing associated with turbulence generated by the strong air-sea forcing in a typhoon. These observations will be used to make quantifiable assessments of mixed layer models under the extreme conditions of a typhoon.

OBJECTIVES

• Study the upper ocean response to typhoon forcing, in particular the evolution of the cold wake, using glider and ship measurements.

• Use a microstructure sensor package system on a glider for acquiring unprecedented measurements of turbulence during storms.

APPROACH

Craig Lee (APL), Steven Jayne (WHOI), Louis St-Laurent (WHOI), and I are coordinating the use of glider and ship measurements to study the evolution of the cold wake typically observed in the upper ocean after the passage of a typhoon. Eight Seagliders (APL) and one SLOCUM glider (WHOI) will provide a context for the ITOP measurements, observing the mesoscale and internal wave fields. The current plan is to deploy four Seagliders in the spring 2009, and three to four Seagliders and the SLOCUM glider during the ship-based survey in September 2009. As part of that effort, I am leading the integration of micro-temperature sensors to two Seagliders.

The two Seagliders equipped with micro-temperature sensors and one SLOCUM turbulence glider will be deployed as part of the ship wake study. The SLOCUM glider will be recovered at the end of the cruise, but the two turbulence Seagliders, along with the other standard gliders, will remain in the area until the end of the ITOP field program. They will eventually be recovered as part of the mooring recovery cruise.

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14. ABSTRACT
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During the wake survey, the ship will be equipped with a towed-profiler, sampling tracks over 350 km long per day. During the same time, the 4-5 gliders (including our 2 micro-temperature Seagliders) can sample about 20 km. Sampling the top 200 or 300 m of the water column allows for horizontal resolution of about 1 km for both. The micro-temperature sensors will be fully integrated to the Seaglider, with a modified instrument holder. We do not expect significant impact on drag or for mission duration.

In a high-resolution simulation of a typhoon wake evolution, Baylor Fox-Kemper (Colorado University) finds that submesoscale eddies (1-10 km, 5-7 days) are likely to play a dominant role. Our sampling strategy (Figure 2), combining ship and gliders, will resolve the high temporal and spatial variability of the restratification process.

WORK COMPLETED

Accelerometers

A new electronic package that includes 3-D fast accelerometers has been designed and built at APL to measure the vibration of the Seaglider at high frequencies (up to 50 Hz). The board has been tested in the lab and shown to meet the specification required to measure the vibrations that might cause difficulties for turbulence measurements. More generally, these measurements will be helpful for Seaglider development. We expect to fly a glider with the accelerometers in October or November 2009. Knowledge of the vibrations of the glider during normal operating conditions will guide the development of future turbulence capacity (the potential use of micro-shear probes).

Micro-temperature sensors

Two Seagliders will be equipped, each with 2 micro-temperature sensors. All the microstructure controller electronics will be housed inside the present pressure case. We will use the commercially available FP07-38 thermistors (Rockland Scientifics). The boards (thermistor circuit, anti-alias board, A/D board. And CF2 controller) have all been designed, and assembly has started. Three copies are being made (for two gliders, and a spare). All the controller electronics will be ready for testing and calibrations in October 2009. The firmware required for the micro-temperature sensor and Seaglider integration is ready.

We are currently designing the new instrument holder ("CTD sail" sitting on top of the glider) to accommodate two micro-temperature sensors. They will be sitting above and forward of the current temperature sensor and conductivity cell.

Schedule

Oct 2009	build and test the circuit boards
Nov 2009	interface boards and thermistors
Dec 2009	all hardware on hand, connected and working
Jan 2009	Port Susan, WA, testing
Aug-Sep 2010	ITOP deployment

RESULTS

We have no scientific results yet.

IMPACT/APPLICATIONS

TRANSITIONS

RELATED PROJECTS

The ITOP measurements will take place in region where with large internal tides, propagating from Luzon Strait. Knowledge of the dynamics of those waves will be an important factor for the interpretation of the various ITOP datasets. The eastward propagation from Luzon Strait is also one of the objectives of the IWISE DRI. We are evaluating the existing data (drifters, floats, gliders) east of Luzon and working with modelers (Simmons, Ko) on these questions.

REFERENCES

PUBLICATIONS

No publications have been associated with this project yet.

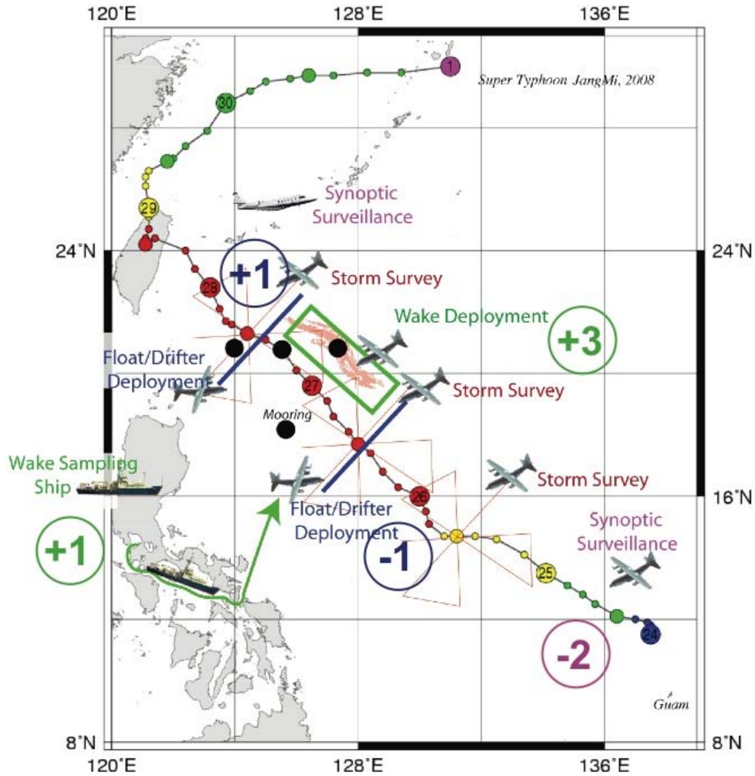

Figure 1: Sampling plan for ITOP, schematically shown using the track from 2008 typhoon Jangmi. The decision to sample a storm can probably be made 2 days before (-2) it reaches the measurement area (green box). Drifters and floats will be air-deployed a little bit ahead and after the storm: (-1) and (+1). Also on the day following the storm (+1), the ship will leave port, reaching the survey area about 3 days after the storm (+3). By then the drifters and floats will likely have been dispersed by eddies and mean currents.

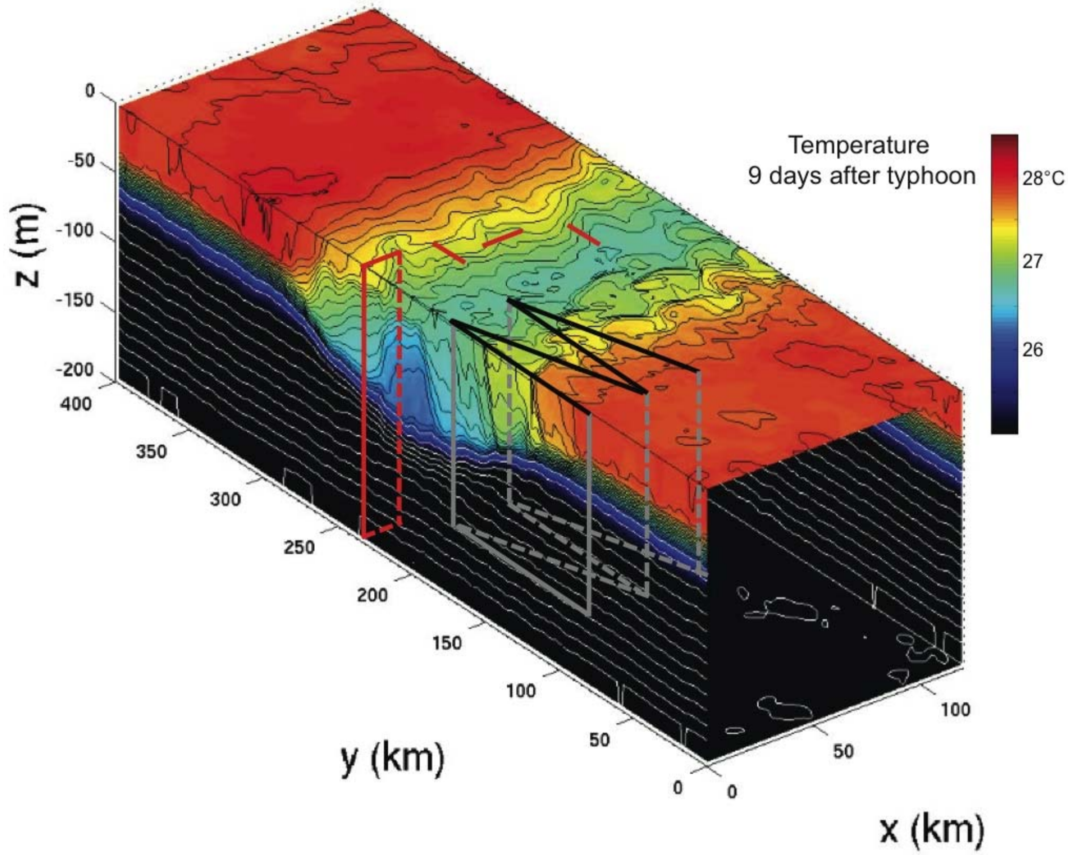

Figure 2: Example of ship (black) and glider (red) tracks during the wake sampling experiment. Colors indicate the temperature of the water column 9 days after the passage of a typhoon in a numerical simulation run by Baylor Fox-Kemper (Colorado University). Four 90-km transects are shown for the ship (black zig-zag), and the tracks of 4 gliders, each covering 15 km are shown.